EFFECTIVENESS OF AN INDIVIDUALISED SENSORY STIMULATION PROGRAM FOR HIGH RISK INFANTS LESS THAN THREE MONTHS OF AGE

A PROJECT WORK SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF OCCUPATIONAL THERAPY

(ADVANCED O.T. IN PEADIATRICS)

Submitted By

Reg No. 41091206

JKK MUNIRAJA MEDICAL RESEARCH FOUNDATION
COLLEGE OF OCCUPATIONAL THERAPY
KOMARAPALAYAM – 638 183

Affiliated by

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PRINCIPLE	**EXTERNAL EXAMINER**
GUIDE	**INTERNAL EXAMINER**

CERTIFICATE

This is to certify that the Project work entitled, "**EFFECTIVENESS OF AN INDIVIDUALISED SENSORY STIMULATION PROGRAM FOR HIGH RISK INFANTS LESS THAN THREE MONTHS OF AGE"** Is a bonafide compiled work carried out carried out by **Reg. No. 410911206,** Final year student, College of Occupational Therapy under J.K.K. Munirajah Medical Research Foundation, Komarapalaym -638 183, in partial fulfillment for the award of Degree of **"Master of Occupational Therapy" (Advanced O.T. in Paedatrics)** of **The Tamilnadu Dr. M.G.R. Medical University, Chennai-32.** This work was done under my supervision and guidance

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ABSTRACT

AIM:

To find out the effectiveness of an individualized sensory stimulation program for high risk infant less than 3 months of age.

METHODS:

Twenty two high risk infants were selected for the study and were randomly assigned to the control and experimental group. Each group had 11 infants of which 4 were female and 7 were male.

The "sensory profile" was used to evaluated the infants development in the five (ie) visual auditory, tactile, vestibular and proprioceptive.

RESULTS:

Sensory stimulation in the first 3 months of life is beneficial in facilitating the development of high risk infants.

KEYWORDS:

High risk infants, sensory stimulation therapy, sensory profile.

INTRODUCTION

Human development is a continuous process and involves the motor, sensory, perceptual, cognitive, emotional and cultural systems. All the developing systems of the infant and child are inter-related. Some take precedence over others at varying stages of development. The maturation of the Central Nervous System and brain is incomplete at birth. Maturation occurs gradually as a result of environmental input, sensory stimulation and cultural influences. The sensory system thus plays an important role in Central Nervous System maturation during infancy.

Sensory function is defined as the action of the environment upon the organism and the reaction of the organism to the environment *(Ayres, 1973).* A normal newborn has the capacity to perceive a large range of sensory stimuli in a well organized manner and is remarkably responsive to visual, auditory, somatosensory and vestibular stimulation. The ability to perceive and act upon these various sensory stimuli to produce an adaptive response is the basis for further development and parent – infant bonding.

High risk infants are those, who have a potential to develop developmental disabilities, as a result of events that occurred prenatally, perinatally and postnatally. These infants are especially vulnerable and liable to manifest difficulties with sensory processing, and therefore have problems in producing age-appropriate adaptive responses. In addition the development of these high risk infants depends on the environment in which they live. These infants and their parents are vulnerable to adverse interactions because of increased stress, anxiety, grief, disappointment and guilt associated with the birth. The infants themselves may be less rewarding, less predictable and more difficult to raise.

Facilitating an infant's organization of the sensory information to produce age-appropriate adaptive responses is one of the occupational Therapist's unique contributions to developmental care and early intervention. Therapy is aimed at balancing the environmental input with the infant's current sensory processing and organizational abilities so as to promote optimal development. The value of early sensory stimulation is to provide an increase in an infant's everyday experiences and interaction, and thereby facilitate adaptive responses and bonding with the caretaker.

This study was done to evaluate the effectiveness of a parent focused individualized stimulation program on the development of high risk infants in the first three months after birth.

AIM AND OBJECTIVES

AIM

To find out the effectiveness of an individualized sensory stimulation program for high risk infants less than 3 months of age.

OBJECTIVES

1. To compare the development of the sensory systems in the Normal and High risk infants.
2. To evaluate the effectiveness of an individualized sensory stimulation program in facilitating the development of the sensory systems, and thereby facilitating normal development in high risk infants.
3. To evaluate the effectiveness of a parent focused intervention in facilitating infant development.

HYPOTHESIS

ALTERNATE HYPOTHESIS

There will be significant improvement in the development of the Sensory systems through individualized sensory stimulation programme among high risk infants under 3 months of age.

NULL HYPOTHESIS

There will be no significant improvement in the development of sensory systems through individualized sensory stimulation programme among high risk infants under 3 months of age.

REVIEW OF LITERATURE

PhD, BSc (Hons) Julie Anne Hayes Applied Psychology, RGN 1 June 2006. This paper describes a non-pharmacological stroking intervention which has been used with premature infants. This intervention is referred to as Touching and Caressing, Tender in Caring (TAC-TIC) therapy. Some of the beneficial outcomes resulting from TAC-TIC in healthy preterms are outlined, along with some of the initial findings from research using the therapy with the high-risk ventilated premature neonate. In recent years much research has been conducted on the effects of supplemental stimulation on the maturation of high risk infants. A look at some of the previous studies will give a clearer understanding of the developmental dysfunctions in high risk infants and effectiveness of early sensory stimulation in facilitating normal development.

J Obstet Gynecol Neonatal Nurse.(2004), Cambridge Journals Onlie. Developmental patterns of physiological response to a multisensory intervention in extremely premature and high-risk infants. Thirty-seven premature infants born at 23-26 weeks with normal head ultrasounds or at 24-32 weeks and diagnosed with periventricular leukomalacia (PVL) and/or intraventricular hemorrhage (IVH) were studied at 33-35 weeks postconceptional age. Infants were randomly assigned to control and experimental groups. The experimental group infants received auditory, tactile, visual, and vestibular (ATVV) multisensory intervention twice daily from 33 weeks postconceptional age (PCA) until hospital discharge. HR, RR, and SaO_2 were continuously monitored during baseline, intervention, and the 30-minute postintervention period. The result shows between 33 and 35 weeks PCA, control group infants with and without CNS injury and experimental group infants without CNS injury had a significant decrease in resting mean HR, whereas RR and SaO2 remained stable. The infants with PVL who received the intervention showed increases in HR even at rest.

Conclusions: The absence of a weekly decline in HR for experimental group infants with PVL suggests that PVL may affect maturation of the autonomic nervous system and increase risk of decelerative HR changes and associated clinical compromise. Infants diagnosed with PVL should be closely monitored during procedures or interventions that may be stressful or involve handling. Further research is needed to tailor multisensory interventions for infants with PVL

Raweewan Lekskulchai, Joan Cole: 2001 Conducted a randomized controlled trial to evaluate the effect of a Motor Developmental Program in improving motor performance in Thai infants born pre-term. Eighty four pre-term infants were randomly assigned to a control or intervention group. Additionally 27 low risk pre term infants were included forming a comparative group for this study. The motor performance was assessed monthly, from term equivalent age to four months adjusted age with the test of infant motor performance. The intervention infants received a developmental program which was upgraded at each monthly visit the intervention group showed the greatest improvement with significant differences across age and among groups.

Thus the results suggest that an early intervention program is likely to have a beneficial effect when offered to a similar population of pre term born infants (J9).

J Perinatol. 2000 Atypical perinatal sensory stimulation and early perceptual development: insights from developmental psychobiology. Lickliter R. Comparative studies utilizing avian and mammalian embryos and neonates have proven particularly useful in exploring how alterations in sensory experience during the perinatal period can affect subsequent development. This article reviews research drawn from comparative developmental psychobiology and concludes that the effects of modified sensory stimulation on perceptual and behavioral development depend on several related factors, including the timing of stimulation relative to the developmental stage of the young organism, the overall amount of sensory stimulation provided or denied, and the type of sensory stimulation presented. Directions for future research on the care of the high-risk infant are discussed.

Majnemer A. Rosenblatt B, Riley PS : 1993, Determined the influence of gestational age, birth weight and asphyxia on neonatal neurobehavioral performance at 40 weeks conceptual age. Seventy four high risk newborns were selected from a sample of asphyxiated, very low birth weight and small for gestational age neonates. There were 37 healthy term and 17 low risk pre term controls. The neonates were evaluated using the Einstein Neonatal Neurobehavioral Assessment Scale. Results revealed statistically significant differences between high risk newborns and term controls for the total score ($p < 0.001$) as well as for most individual items ($p < 0.05$). Analysis of high risk subgroups revealed that small for gestational age and term asphyxiated newborns had the most abnormal responses. When comparing test performances between preterm high risk and term controls, the majority of the test items achieved significance ($p < 0.05$), however, when compared to low risk preterm controls, fewer items were abnormal (J10).

Am J Occup Ther. 1988, An efficacy study of occupational therapy with high-risk neonates. Case-Smith J. Department of Occupational Therapy, Virginia Commonwealth University, This single-subject research study with replication evaluated the effect of daily occupational therapy on the nutritive and nonnutritive sucking behaviors of three high-risk, premature infants. At the time of entrance into the study, the infants were 34 to 35 weeks old and were documented poor feeders. Treatment consisted of individual, multimodal sensory stimulation, with emphasis on proprioceptive and vestibular input, graded to the sensory needs of the infants. Movement components of the jaw and tongue during nutritive and nonnutritive sucking were measured during baseline and intervention phases to assess the infants' sucking ability. A comparison of testing results revealed that during intervention the total sucking scores improved significantly for two of the three infants and that rapid changes occurred in the oral-motor function of all three infants. The results of the study suggest that occupational therapy can improve the rate of development of sucking in the premature neonate. However, future research needs to be done to isolate the specific techniques of treatment that produce positive changes.

Resnick MB, Eyler FD, Welson RM, et al ; 1987, Reported similar results after a developmental intervention program that began while low birth weight, premature infants were still hospitalized in the intensive care nursery and then continued into the home for the first 2 years of life. The intervention approach was primarily parent focused and attempted to enhance the quality of the parent child relationship. Experimental group infants scored significantly higher than control group infants on the Bayley Mental and Motor Scales at 12 and 24 months corrected age.

These investigators have subsequently concluded that it appears to be more advantageous developmentally to work directly with parents, modeling interventions for them to use with their infants than to work exclusively with infants. Consequently, they believe that parents should be integrated into the developmental intervention program from the very beginning in the NICU so that they can learn to respond appropriately to the infant's cues and social overtures (J14).

Pediatric Neurol. 1987 The Effectiveness of Tactile Stimulation as a Form of Early Intervention, The results of studies examining the effectiveness of tactile stimulation as a form of sensory enrichment for infants and young children were analyzed by the use of recently developed quantitative methods that treat research synthesis as a unique type of scientific inquiry. Nineteen studies meeting certain predetermined criteria were included in the review. The 19 studies contain 103 statistical hypothesis tests that evaluated the effectiveness of tactile stimulation programs. Analysis of these tests, based on the calculation of effect sizes, revealed that subjects receiving some form of controlled tactile stimulation performed better on a variety of dependent measures than subjects not receiving intervention. Larger treatment effects were associated with pre-experimental designs, and also with studies in which the internal validity was rated as poor. Several other study characteristics, such as how the subjects were assigned to conditions and how the dependent measure was recorded, were related to study outcome as measured by effect size. The results indicate that an accurate interpretation of tactile stimulation studies cannot be made without consideration of specific design variables and study characteristics.

Am J Occup Ther. 1986, Sensory intervention with the preterm infant in the neonatal intensive care unit. Anderson J. Sensory intervention, one aspect in the occupational therapy treatment of the high-risk, preterm infant in the neonatal intensive care unit (NICU), is discussed. Normal deviations in the healthy preterm baby's development at the equivalent age of the full-term baby are identified as a basis for intervention. Environmental factors affecting the preterm infant's interactions and therapeutic needs, such as the NICU environment and medical intervention, are reviewed. The rationale underlying the selection of sensory evaluation and treatment approaches is based on recent research. These approaches primarily focus on visual, tactile, proprioceptive, vestibular, and, to a lesser degree, auditory stimulation.

Barrera ME, Rosenbaum PL, Cunningham CE; 1986 Conducted a year long home intervention with low birth weight, premature infants and their parents after nursery discharge. Study subjects were randomly assigned to one of the 3 groups :

1. An infant focused intervention group with the objective of stimulating and enhancing developmental skills.
2. A parent focused intervention group with the objective of improving the quality of the parent – infant interaction and
3. No – treatment control group.

A full term no treatment comparison group was also used. Their results indicated that although both intervention approaches were effective in modifying some aspects of the home environment and to a lesser degree in improving infants cognitive development, the parent focused approach seemed to have the greater impact. Both of the premature intervention groups consistently outperformed all three premature groups at each evaluation age (4 to 16 months corrected age) on both mental and motor measures (J2).

Lopez CJ: 1983 Studied pre-term infants with histories of respiratory intervention. It was found that these infants vocalize less than healthy pre-term infants. Vocalization consistently decreased with the number of days in NICU. At discharge these infants were totally silent unless stimulated by an audit or an adverse stimulus (J1).

Holmes dl, Nagy JN, Slaymaker F, et al : 1982 Found that pre-term and full term infants who required intensive care performed significantly more poorly than healthy full term infants on the motor and interactive items of the Brazelton Assessment Scale regardless of gestational age. Furthermore, those with prolonged hospitalization performed more poorly on state organization items than the control group. A possible interpretation of these findings is that the pre-term infant's problems in behavioral organization may be attributed not only to prematurely but also to the severity of medical complications, the prolonged hospitalization and the influence of environmental factors (J1).

Rose G: 1982 Studied visual recognition memory in 6 month old pre-term and full term infants. It was found that pre term and full term infants had similar performance, as long as the familiarization time was lengthened for the pre term infants. This study was compared with a previous study done with similar subjects. In the first study, pre term babies after a brief familiarization period, failed to differentiate between novel and familiar stimuli, while the full term group demonstrated significant preferences for two out of three novel stimuli. However, the performances of pre term infants who had received tactile and vestibular stimulation for two weeks after birth was indistinguishable from the performance of the full term group. The results of these studies suggest that pre term and full term infants have similar abilities to store and retrieve visual information; however, pre-term babies may have a deficit in the speed of information processing. Furthermore, early tactile and vestibular stimulation may have positive long term effects on the pre-term infant's sensory performance (J1).

Sibylle k Escalona : 1981, Studied 114 infants and their families from birth to age 3 ½ years in order to investigate the interaction between biologic and social factors as they impinge upon the mental and psychosocial development of low birth weight infants. The group showed normal cognitive development through age 15 months. By 28 months of age and thereafter, a severe decline in cognitive status proved to be associated with social class. Neither neurologic pathology (excepting severe brain damage) nor gestational age [small for gestational age (SGA) vs. appropriate for gestational age (AGA)] has a significant effect on IQ scores at 3 ½ years of age. This study suggested that environmental deficits and stresses impair early cognitive and psychosocial development for both full term and premature infants, but that the latter group is more vulnerable to environmental insufficiencies than are full term babies (16).

Filed, Widmayer, Stringer, Ignatoof ; 1980 Reported a study including two groups of low socio economic status (SES) black, teenage mothers and their pre-term infants. The mothers in the experimental group were trained in age appropriate stimulation procedures via biweekly home visits. Intervention consisted of providing parent training in infant stimulation techniques, education about infant developmental milestones and ways to increase communication skills and positive mother – infant relationships. Intervention efforts for the experimental group resulted in more optimal growth, higher Denver developmental screening test scores and more face to face interaction at 4 months (13).

Miranda, Hall: 1977, Evaluated the neonatal pattern of vision as a predictor of mental performance. The study showed that infants who did not respond in the usual way to specific visual stimulation were usually considered high risk for neuralgic mental handicap. The neonatal performance of visual perceptual tasks was found to be highly related to estimates of later intellectual functioning (J11).

Rice: 1977 Rice Infant Sensor motor Stimulation (a specific cephalo –caudal massage) was taught to 15 months by visiting nurses. They applied the stimulation 4 times a day, for the first month the infant was at home, following discharge from the intensive care nursery. Home visits were made to encourage the mothers to continue the stimulation procedure. At 4 months of age the infants had made marked gains in neuralgic development, weight gain and mental development. Rice concluded that this parent provided treatment improved the infant's development and suggested that it also enhanced the mother – infant relationship (J15).

Powell: 1974 assessed a group of handled infants at 2, 4 and 6 months using the Bailey scales of Infant Development. He found significantly better scores at 4 months on both the Mental Developmental Index and the Psychomotor Developmental Index for the stimulated infants (13).

Sandra Scarr – Salapatek, Margaret l. Williams: 1973 Conducted a study on 30 low birth weight, socially disadvantaged infants to demonstrate the advantages of early intervention. The 15 infants in the experimental group were given special visual, tactile and kinesthetic stimulation by the nurse in the nursery. The control group received standard pediatric care for low birth weight infants. They were maintained in the isolates, being fed and changed with minimum disturbance. After discharge, the experimental group continued to get follow up care once a week by the Child Guidance Social Worker.

The results showed that the early stimulation program for the experimental group was effective in promoting development. The nursery stimulation program offset the initial advantages of the controls and gave the experimental group a slight developmental advantage at 4 weeks of age. At one year of age the experimental group had significantly higher developmental quotients than the control group who did not receive home intervention. The result of this study supports programs of early intervention for biologically socially disadvantaged infants (J16).

Spitz : (1945–1946) In a classic study, Spitz demonstrated extreme sensory deprivation in severally affected children growing up in English institutions, where all physical needs were met but important sensory input was lacking. The result needs were met but important sensory input was lacking. The result of this study as well as others and Lip **(Casler, 1961; Goldfarb, 1943; Provence and lip**ton **1962),** suggests that early sensory stimulation in a variety of contexts may play an important role in normal development (J12).

Clark – Stewart 1973 Conducted studies on the quality of material stimulation and its effects on a child's development. They found that a child's intellectual development is correlated with the quality of maternal responsiveness. They suggest that increased qualitative stimulation by the mother leads to enhanced intellectual and social performances in later life (3).

RELATED LITERATURE

SENSORY DEVELOPMENT

Sensory modalities include systems for tactile, vestibular, proprioceptive, visual and auditory awareness. All these senses are inter-related and inter-dependent and are crucial for normal development.

Normal Development: 0 – 3 Months

TACTILE SYSTEM

The tactile system is functioning in Utero and is fundamental for learning about self and the environment. Tactile information is both protective and discriminative. Initially the infant reacts in a gross, protective manner to touch stimuli, and then becomes more discriminative in relating to these experiences. Sensitivity to light touch is dramatically demonstrated by an infant's reflexive response. A newborn infant can interpret some of his body sensations and respond with built in reflex movements (e.g. rooting reflex). Although these innate reactions are automatic the sensations must be integrated for the reflex to occur in a meaningful and purposeful way (2). The sensation from a wet diaper makes the infant uncomfortable, while the touch of his mother's hand is comforting. In the first few months the touch sensations are more important as a source of emotional satisfaction. The touching between an infant and his mother is essential for brain development and the development of the mother infant bond.

Vestibular System

The vestibular system is one of the most well advanced sensory systems, in terms of both morphology and function (14). Its function is to modulate movement and is essential for maintenance of the body and head in space. The sensory receptors for vestibular information are located in the inner ear, and consist of the semicircular canals, which process information about gravity motion and rotation of the head, and the utricle and saccule, which process motion with respect to the position of the head (9).

The moro reaction and the righting reactions (labyrinthine and neck righting) are used to assess vestibular function, in addition to the infants responses to other movement activities such as rocking. The sensations of gentle body movements tend to organize the brain and are therefore essential building blocks for other sensations and for self determined body movements.

Proprioceptive System

The system for proprioception receives information from special receptors in the joints, muscles, and tendons to provide knowledge about the body's position in space. These sensations stimulate the nervous system to produce movements and tonal changes. For example, turning of the head to one side elicits the asymmetrical tonic neck reflex (ATNR) (2).

The vestibular and proprioceptive systems function jointly to supply and react to information about gravity, movement and position in space (9).

Visual System

Contrary to past beliefs, vision is functioning at birth. At birth, the eye is fairly well developed. The new born infant appears to have 20/150 vision with a fixed focus of about 20 cms and displays little accommodation (14). The newborn infant also displays visual fixation and visual following. The neonate's visual world is selective and they seem to prefer curves and and corners over straight contours. Infants also have early preference for sharp contrast, i.e. black and white stimuli, as well as for faces (9).

At one month of age infants can recognize their mothers based on visual information and will actually imitate facial gestures (14). Social smile usually develops by the first or second month. Visual fixation and following is well developed by 3 months of age and contribute further to visual motor development. Evidence suggests that visual fixation ratings for newborns are better predictors of IQ at 3 to 4 years of age than are newborn neurological ratings (14).

Auditory System

Current research suggests that within the general range of pitch and loudness of the human voice, infants hear as well as adults, although adults are more sensitive to quiet sounds (9). At first the baby responds to hearing with a total body reaction of movement or quieting.

Subsequently the infant orients to the sound and seeks its source. By 3 months of age, infants are able to localize auditory stimuli.

High Risk Infants

High risk infants are those infants who are likely to develop significant developmental deviants as a result of events that occurred prenatally, perinatally and postnatally.

Risk Factors Include (8).

- Prematurity – any neonate born before the 37th week of pregnancy.
- Low birth weight – any neonate weighting less than 2500 gms at birth irrespective of the gestational age.
- Intrauterine and perinatal infections.
- Neonatal sepsis – Septicemia, Pneumonia and Meningitis.
- Respiratory Disorders – including Respiratory distress syndrome, Meconium aspiration syndrome, Bronchopulmonary dysplasia, Apnea.
- Neonatal jaundice and hyperbilirubinemia.
- Neurological and metabolic problems such as hypoxic ischemic encephalopathy, neonatal seizures, neonatal hypoglycemia.
- Congenital malformations such as hydrocephalus, cleft lip and cleft palate, microcephaly, etc.

SENSORY DYSFUNCTION IN HIGH RISK INFANTS

Sensory stimuli must be received or registered by the brain for a response to be evoked. When any of the sensory systems are dysfunctional, responses to stimulation may be diminished, aberrant or absent. In high risk infants, interruption of sensory reception may occur peripherally such as poor visual or auditory acuity, or may take place once the information gets to the brain, causing a central processing problem (9).

Tactile System

A high risk infant's tactile experiences may be inconsistent, unpleasant and painful during the acute phase of hospitalization. Reduced active postural tone and reduced spontaneous movement frequently seen in preterm infants may cause decreased tactile exploration. Poor environmental stimulation at home may reduce the positive tactile interaction between the parents and the child, thereby, affecting the emotional bonding. The infant may also have poor protective responses to touch and delayed development of reflexes such as rooting and grasp.

Vestibular System

In a high risk infant, the normal vestibular input may be reduced, due to static positioning for prolonged periods or as a result of decreased holding and rocking during the acute phase of care. This may affect the development of the righting reactions of the head in prone and supine, thereby hindering motor development. Further, the high risk infant may respond adversely to movement transitions and may not be comforted by rocking. The absence of the moro reflex in these infants is a definite indication of an abnormality.

Proprioceptive System

Proprioceptive input may be reduced in high risk infants as a result of poor handling. During hospitalization, infants on ventilators or intravenous tubes are frequently maintained in supine or side lying positions. Thus they may be deprived of lying prone, the position considered best for developing early head control. After discharge parents very often are unaware of the need to position the infant in prone, further delaying the development of head control.

Visual System

Research has shown that neonates who scored low on fixation and following had suspect gross motor performance at 4 years (11). A visual defect may affect the age of smiling, eye following and manipulation and thus hinder visual motor development.

Auditory System.

High risk infants may have poor orienting responses to auditory stimuli manifested as a lack of alerting, attentional responses and head turning. This may adversely affect social interaction and language development.

A dysfunction in the sensory systems is therefore detrimental to the overall development of the infant. Sensory defects may lead to emotional deprivation and reduced manipulation or other experiences. One defect may lead to another, so that development is retarded by a combination of factors (10). Moreover, it has been suggested that by 3 months of age a great deal of important interaction between infants and their parents has already occurred and that future patterns may already be set (12).

An attempt should be made, therefore, to capitalize on the flexibility and pliability of the young nervous system to influence its development through early intervention. It is necessary to develop the central nervous system to its fullest potential so that it is compromised to its minimum (7). It is also essential to give these high risk infants more normal experiences through early sensory stimulation before more serious abnormal patterns are established.

PARENT – INFANT INTERACTION AND ITS EFFECT ON DEVELOPMENT

The development of high risk infants depends on the environment in which the infants live. The pattern of interaction with the parents exacerbates or attenuates the influence of biologic risk factors in the child's development (13). Some family environments are so supportive that they compensate for risk factors and later developmental problems are avoided; others are such that they have neither emotional, educational, nor economic resources to adapt to biologic risk factors, children from the latter environments tend to maintain deficits into later stages of development.

Early intervention and parental education is thus required to facilitate optimal parent infant interaction and normal development in these high risk infants.

METHODOLOGY

RESEARCH DESIGN

Quasi Experimental Design.

POPULATION

High Risk Infants with less than 3 months of age.

SAMPLING

Convenient sampling

STUDY SETTING

WCF, Hospital Villivakkam, Chennai.

INCLUSION CRITERIA

1. Full term infants with high risk factors including low birth weight, intrauterine and perinatal infections, neonatal sepsis, respiratory disorders, hyperbilirubinemia, neurological and metabolic problems and congenital malformations.
2. Pre term infants completing 40 weeks conceptual age.

EXCLUSION CRITERIA

1. Full term infants who have had hospitalization for more than one month.
2. Infants more than 3 months of age

EVALUATION TOOL

The “sensory profile” evaluation format was used to assess the sensory development in the study group. The format evaluates the development of the five sensory systems i.e. visual, auditory, tactile, vestibular, and proprioceptive systems in an infant. This form was standardized on 100 normal infants between 0-3 months of age. This data was used for comparison with the study group. Assessment guidelines are given in the appendix.

PROCEDURE

The high risk infants selected for the study were randomly assigned to control and experimental groups. The infants in the control group received the routine care including follow up and therapy by the occupational Therapist in the OPD once a month.

The experimental group was subjected to a sensory intervention program for a period of 6 weeks, with once a week follow up in the hospital. It included parental education and training the first day of intervention.

Initial evaluation was done on the first day, midterm evaluation after 3 weeks and final evaluation at the end of 6 weeks.

SENSORY INTERVENTION PROGRAM

The high risk infants in the experimental group were given a sensory stimulation program which was individualised and based on an interpretation of the evaluation findings.

Sensory intervention consisted of applying multi modal sensory stimulation through the visual, auditory, tactile, vestibular and proprioceptive systems.

Visual Stimulation : Colorful toys mobiles and the mother's face were used to stimulate visual fixation and tracking. The mother was taught to position the child to encourage face to face interaction.

Auditory Stimulation : Toys with soft, low sounds, soothing music and talking to the infants, were used to facilitate altering and auditory localisaiton. The parents were told to avoid sudden harsh sounds. The stimulation was done in a quiet environment.

Tactile Stimulation : The infants were given gentle but firm stroking on the upper and lower extremities. Self generated tactile exploration was facilitated through hand to mouth and face activity. Oral sensitivity was facilitated by moving the infants hand externally on the face in motions towards the month. The parents were told to avoid light touch as it tends to increase behavioral disorganization.

Vestibular Stimulation : The parents were taught to rock the infants gently while cradling the child in the arms. Movement transitions were also provided by frequently changing the infants body position i.e. lying prone, side lying, supine and carrying the infant in various positions. The parents were advised to place the infants in the cradle at home for short periods.

Proprioceptive Stimulation : The parents were taught to position the infants in supine and side lying in a flexed posture with adequate blanket rolls for support for the feet and body. The infants were swaddled in between stimulation periods and when being carried. The infants were also positioned in prone position to facilitate weight bearing.

Each intervention was individualized to the infant's needs and was graded based on the infant's behavior and reactions. Initially uni model stimulation was used. When the infant could tolerate more than one stimulus, then several modalities were integrated to provide multi modal stimulation. Signs of over stimulation including yawning, increased drowsiness, fussiness, gaze aversion were observed and treatment was modified accordingly.

The parents were taught to observe for signs of readiness for interaction before the stimulation. Sings of readiness included relaxed muscle tone, quiet alert state, periodic eye contact and hand to mouth movements. The parents were also taught to minimize environmental stimulation during intervention at home.

Parental education included discussion regarding the infant's biological rhythms, sleep wakefulness, and readiness cues. By mutual observation and discussion the parents were helped to gain skill in observing the infant's posture, facial expression and so forth as signals of the infant's needs. They were taught the sensory stimulation techniques to be followed at home and were shown how to encourage adaptive behavior through the stimulation. The parents were also educated regarding what to look for and how they can prepare for and assist development.

DATA ANALYSIS AND RESULTS

Twenty two high risk infants were selected for the study and were randomly assigned to the control and experimental groups. Each group had 11 infants of which 4 were female and 7 were male. Nine out of 11 infants in each group were pre-term infants while 2 were full term infants.

The "sensory Profile" was used to evaluate the infants' development in the five sensory domains i.e. visual auditory, tactile, vestibular and proprioceptive. Each sensory domain had subdomains which were scored on a scale of 0-3. the scores of all the subdomains were added to give the total score for each sensory domain.

The following statistical formulae were used for analyzing the data :

1. Mean (X) is calculated by :

$$\sum X$$

$$X = N$$

Where : $\sum$ = sum of

X = scores in a distribution

N = number of infants

2. Standard deviation (SD) is calculated by:

$$SD = \sqrt{\frac{\sum(x-x)^{-2}}{N}}$$

Where: x = scores in a distribution

X = mean

N = number of scores

3. Standard error of the mean (SEM) is calculated by :

$$SEM = \frac{SD}{\sqrt{N}}$$

Where: SD = Standard deviation

N = Size of sample

4. ‘t’ value is calculated from :

$$T = \frac{\text{Difference between the means}}{\text{Standard error of the differences}}$$

$$T = \frac{\dfrac{X_1 - x_2}{\sqrt{S_1^2 \qquad S_2^2}}}{N_1 \qquad N_2} - 2r \quad \frac{S_1}{\sqrt{N_1}} \quad \frac{S_2}{\sqrt{N_2}}$$

Where:

X_1	=	Mean of the experimental sample
X_2	=	mean of the control sample
N_1	=	number of infants in experimental sample
N_2	=	Number of infants in control sample
S_1	=	Variance of experimental sample
S_2	=	variance of control sample
r	=	correlation coefficient

TABLE NO. 1

DESCRIPTIVE STATISTICS – NORMAL & STUDY GROUPS

		N	MEAN	SD
Birth weight in (Kgs.)	Normal	100	2.77	0.35
	Control	11	1.77	0.46
Head circumference in (cms)	Normal	100	32.84	1.27
	Control	11	30.55	2.37
Socio Economic Status	Normal	100	2688.00	1472.53
	Control	11	2890.91	1592.77
	Experimental	11	2518.18	1803.78

NS= not significant **Sig.= significant**

Table No. 1 shows the comparison of the mean birth weight, head circumference and socioeconomic status between the normal and study groups.

TABLE NO. 2

COMPARISON OF DESCRIPTIVE STATISTICS CONTROL AND EXPERIMENTAL

EXPERIMENTAL Vs. CONTROL	't' Test for Equality of Means		
	't'	Df	Sig. (2 - Tailed)
Birth Weight (Kgs)	1.098	20	0.285 NS
Head Circumference (Cms).	-0.227	20	0.823 NS
Socioeconomic Status	-0.514	20	0.613 NS
High Risk Factor Score	-0.269	20	0.791 NS

NS = Not significant **Sig. = significant**

Table No.2 shows that there is no significant difference at the 0.05 level of significance in the birth weight, head circumference, socioeconomic status and high risk factors between the control and experimental groups. Both the groups were matched in all these aspects before starting the study.

TABLE NO. 3

MEAN AND STANDARD DEVIATION OF NORMALS

Age Group (Weeks)		Age in Weeks	Total Score				
			Visual	**Auditory**	**Tactile**	**Vestibular**	**Proprioceptive**
0-4	Mean	1.67	6.42	7.52	18.26	9.39	18.32
	SD	1.10	2.29	2.11	0.63	1.56	1.35
	N	31	31	31	31	31	31
4-8	Mean	6.62	12.78	9.53	19.47	13.11	17.58
	SD	0.88	4.22	2.41	1.48	2.93	1.81
	N	36	36	36	36	36	36
> 8	Mean	11.58	23.21	13.76	22.39	19.21	14.76
	SD	1.82	6.67	3.31	2.66	3.93	3.05
	N	33	33	33	33	33	33
TOTAL	Mean	6.72	14.25	10.30	20.06	13.97	16.88
	SD	4.19	8.31	3.68	2.48	4.98	2.66
	N	100	100	100	100	100	100

Table No. 3 displays the mean and SD for the normal group. The normal group had been classified according to the age into 3 groups i.e. 0-4 weeks, 4-8 weeks and more than 8 weeks. The results show that the total scores in the visual, auditory, tactile and vestibular domains increase with age. The scores in the domain for proprioception decrease as the age increases.

TABLE NO. 4

MEAN AND STANDARD DEVIATION OF STUDY GROUP

<table>
<tr><td></td><td></td><td></td><td></td><td><u>Experimental</u></td><td><u>Control</u></td></tr>
<tr><td></td><td></td><td rowspan="3">Actual age in weeks</td><td>Mean</td><td>6.23</td><td>6.80</td></tr>
<tr><td rowspan="24">WEEK GROUP</td><td rowspan="17">4 – 8 WEEKS</td><td>SD</td><td>0.15</td><td>0.87</td></tr>
<tr><td>N</td><td>3</td><td>5</td></tr>
<tr><td rowspan="3">Total score on visual</td><td>Mean</td><td>14.67</td><td>4.40</td></tr>
<tr><td>SD</td><td>3.79</td><td>6.54</td></tr>
<tr><td>N</td><td>3</td><td>5</td></tr>
<tr><td rowspan="3">Total Score on Auditory</td><td>Mean</td><td>11.00</td><td>5.20</td></tr>
<tr><td>SD</td><td>2.00</td><td>4.97</td></tr>
<tr><td>N</td><td>3</td><td>5</td></tr>
<tr><td rowspan="3">Total Score on Tactile</td><td>Mean</td><td>19.00</td><td>12.00</td></tr>
<tr><td>SD</td><td>1.00</td><td>5.50</td></tr>
<tr><td>N</td><td>3</td><td>5</td></tr>
<tr><td rowspan="3">Total Score on Vestibular</td><td>Mean</td><td>15.33</td><td>8.40</td></tr>
<tr><td>SD</td><td>4.04</td><td>4.22</td></tr>
<tr><td>N</td><td>3</td><td>5</td></tr>
<tr><td rowspan="3">Total Score on Proprioception</td><td>Mean</td><td>18.33</td><td>8.80</td></tr>
<tr><td>SD</td><td>1.15</td><td>6.30</td></tr>
<tr><td>N</td><td>3</td><td>5</td></tr>
<tr><td rowspan="8">MORE THAN 8 WEEKS</td><td rowspan="3">Actual age in weeks</td><td>Mean</td><td>10.60</td><td>12.08</td></tr>
<tr><td>SD</td><td>1.22</td><td>1.05</td></tr>
<tr><td>N</td><td>8</td><td>6</td></tr>
<tr><td rowspan="3">Total Score on Visual</td><td>Mean</td><td>20.00</td><td>11.33</td></tr>
<tr><td>SD</td><td>8.83</td><td>7.50</td></tr>
<tr><td>N</td><td>8</td><td>6</td></tr>
<tr><td rowspan="2">Total Score on Auditory</td><td>Mean</td><td>12.38</td><td>9.33</td></tr>
<tr><td>SD</td><td>6.35</td><td>5.05</td></tr>
</table>

			N	8	6
		Total Score on Tactile	Mean	22.13	18.83
			SD	3.52	3.60
			N	8	6
		Total Score on Vestibular	Mean	18.38	11.33
			SD	5.15	5.01
			N	8	6
		Total Score on Proprioception	Mean	15.63	14.67
			SD	1.41	4.63
			N	8	6

Table No. 4 displays the mean and SD for the experimental and the control groups. The results show that the experimental group consistently scores better than the control group in all the domains.

The infants in the study groups (experimental and control) were more than 4 weeks of age at the time of evaluation. The 22 infants were classified according to their age into 2 groups i.e. 4-8 weeks and more than 8 weeks. These groups were compared to the normal infants in the corresponding 4-8 weeks and more than 8 weeks group.

TABLE NO. 5

COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AT AGE 4 – 8 WEEKS

Total Score	Group	N	Mean	SD	SEM	T	Df	Sig. (2- tailed)
Age in weeks	Exp.	3	6.23	0.15	8.8E-02	-754	37	0.46 NS
	Cont.	36	6.62	0.88	0.15			
Visual	Exp.	3	14.67	3.79	2.19	.749	37	0.46 NS
	Cont.	36	12.78	4.22	0.70			
Auditory	Exp.	3	11.00	2.00	1.15	1.03	37	0.31 NS
	Cont.	36	6.62	0.88	0.15			
Tactile	Exp.	3	19.00	1.00	0.58	-.538	37	0.59 NS
	Cont.	36	19.48	1.48	0.25			
Vestibular	Exp.	3	15.33	4.04	2.33	1.23	37	0.23 NS
	Cont.	36	13.11	2.93	0.49			
Proprio-ception	Exp.	3	18.33	1.15	0.67	.701	37	0.49 NS
	Cont.	36	17.58	1.81	0.30			

This table compares the mean age and scores between the normal and the experimental infants in the 4-8 weeks group. The results show that both the groups are matched in terms of age and that there is no significant difference in the ages between the two groups at the 0.05 level of significance.

An analysis of the sensory domains revealed no significant difference in the scores between the two groups ($p > 0.05$). This shows that the sensory development of the infants in the experimental groups is equivalent to that of the normal group.

Fig. 1: COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AT AGE 4-8 WEEKS

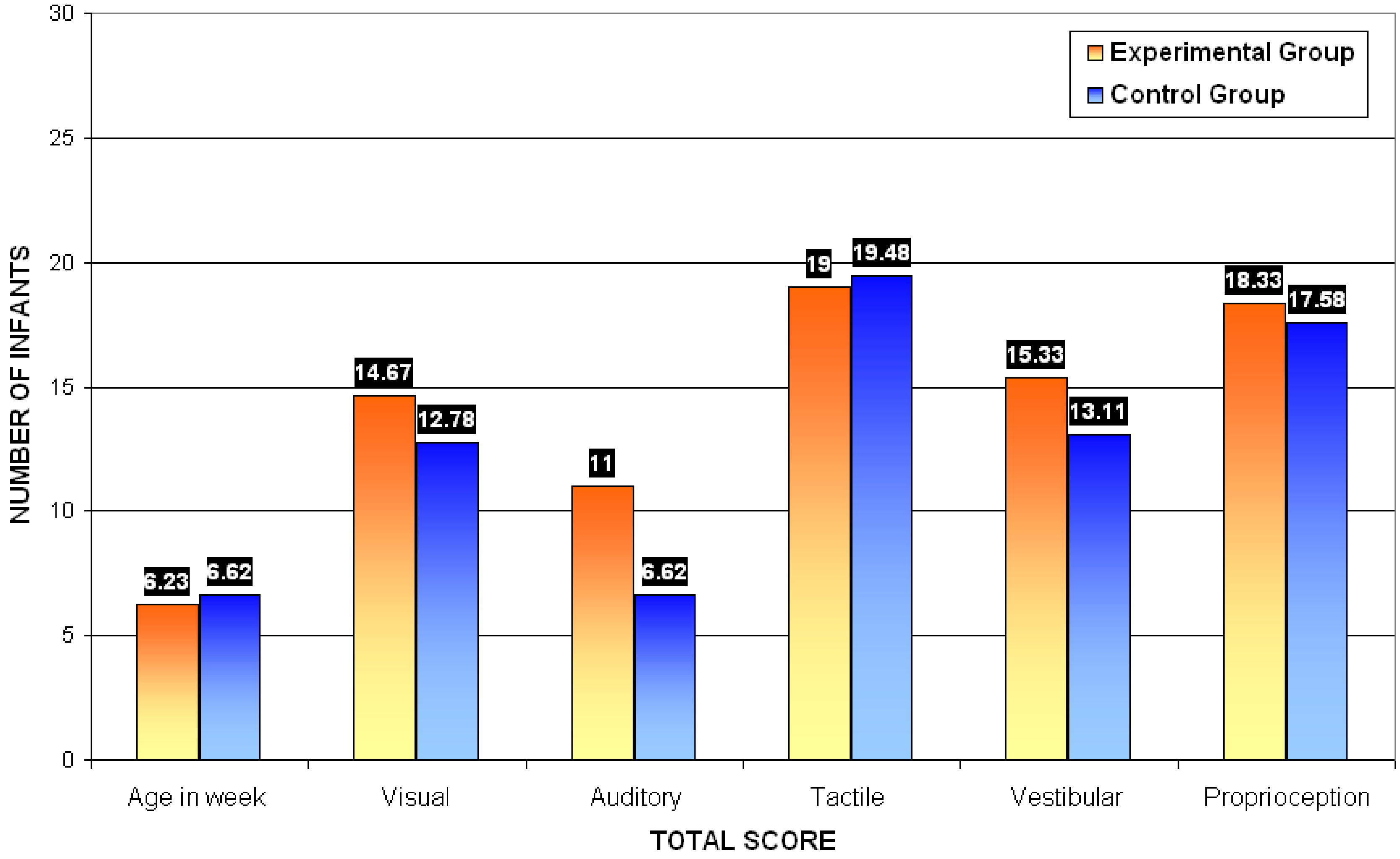


TABLE NO. 6

COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AT AGE MORE THAN 8 WEEKS

Total Score	Group	N	Mean	SD	SEM	T	Df	Sig. (2-tailed)
Age in weeks	Exp.	8	10.60	1.22	0.43	-1.44	39	0.16 NS
	Nor.	33	11.57	1.82	0.32			
Visual	Exp.	8	20.00	8.83	3.12	-1.15	39	0.26 NS
	Nor.	33	23.12	6.67	1.16			
Auditory	Exp.	8	12.38	6.35	2.24	-0.60	39	0.57 NS
	Nor.	33	13.76	3.31	0.58			
Tactile	Exp.	8	22.13	3.52	1.25	-0.24	39	0.81 NS
	Nor.	33	11.39	2.66	0.46			
Vestibular	Exp.	8	18.38	5.15	1.82	-0.51	39	0.61 NS
	Nor.	33	19.21	3.93	0.68			
Proprio-ception	Exp.	8	15.53	1.41	0.50	0.78	39	0.44 NS
	Nor.	33	14.76	3.05	0.53			

This table compares the age and scores between he normal and the experimental in the more than 8 weeks group. The results show that there is a discrepancy in the mean age between the 2 groups, but the difference is not statistically significant ($p > 0.05$). The scores in the five sensory systems are also not significant ($p > 0.05$). the scores in the five sensory systems are also not significant ($p > 0.05$) showing that the infants in the experimental group are at par with the normals in sesory development.

Fig. 2: COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AT AGE MOR THAN 8 WEEKS

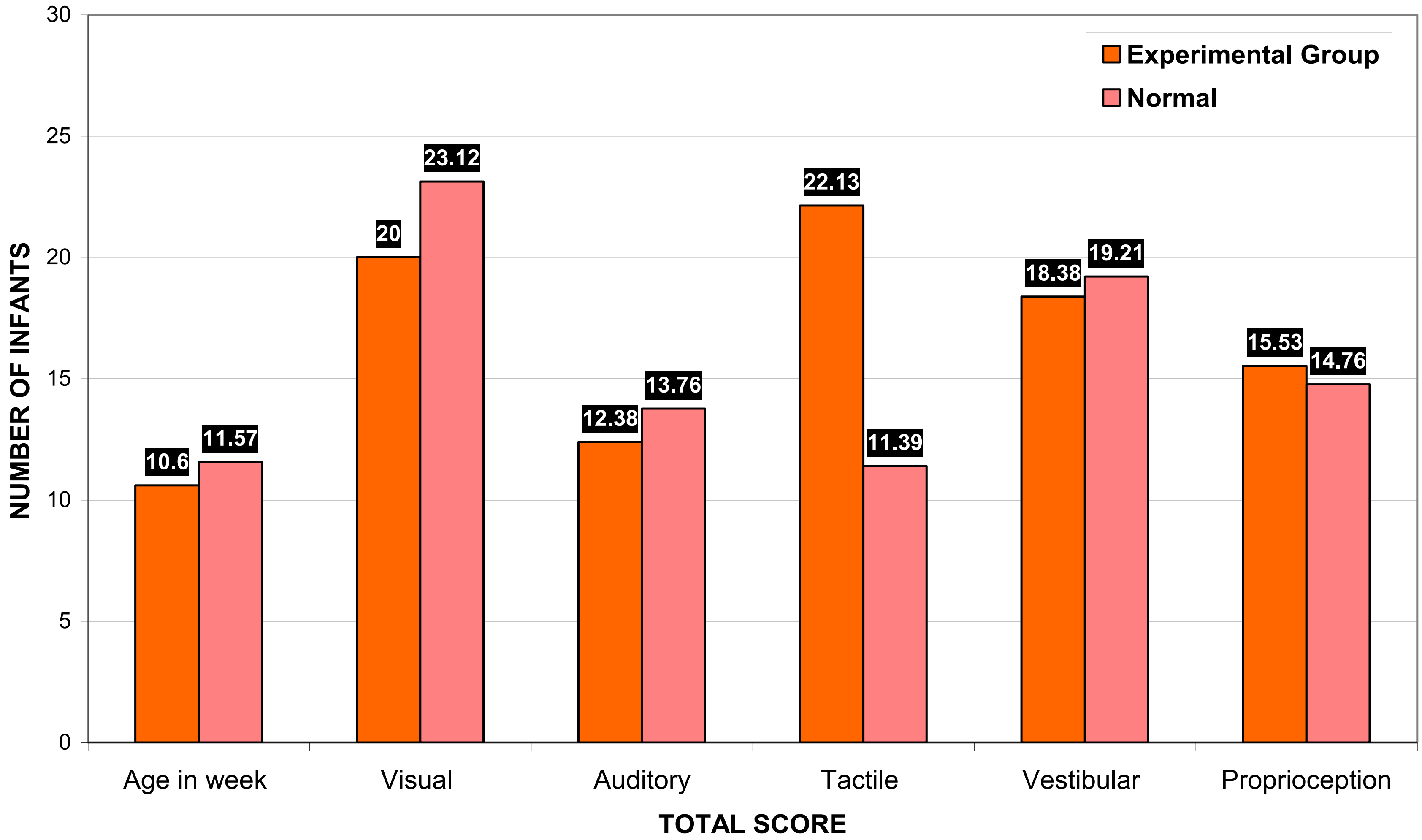


TABLE NO. 7

COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AGE 4-8 WEEKS

Total Score	Group	N	Mean	SD	SEM	T	Df	Sig. (2-tailed)
Age in weeks	Exp.	5	6.80	0.87	0.39	0.42	39	0.67 NS
	Nor.	36	6.62	0.88	0.15			
Visual	Exp.	5	4.40	6.54	2.93	-3.89	39	0.00 NS
	Nor.	36	12.78	4.22	6.54			
Auditory	Exp.	5	5.20	4.97	2.22	-1.92	4.27	0.12 NS
	Nor.	36	9.53	2.41	0.40			
Tactile	Exp.	5	12.20	5.50	2.46	-2.94	4.08	0.04 NS
	Nor.	36	19.47	1.48	0.25			
Vestibular	Exp.	5	8.40	4.22	1.89	-3.20	39	0.00 NS
	Nor.	36	13.11	2.93	0.49			
Proprio-ception	Exp.	5	8.80	6.30	2.82	-3.10	4.09	0.04 NS
	Nor.	36	17.58	1.81	0.30			

A comparison the mean ages of the control and the normal sample showed that there is no statistically significant difference between the 2 groups in the 4-8 month age group ($p > 0.05$).

The sensory development of the control group was found to be significantly less ($p < 0.05$) than the normals in the tactile, and proprioceptive systems. The difference between the groups in the visual and vestibular domains is found to be highly significant ($p = 0.00$) with the control group performing poorly in comparison to the normals. Though there was a difference in the auditory scores between the two samples it was not found to be statistically significant.

Fig. 3: COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AT AGE 4-8 WEEKS

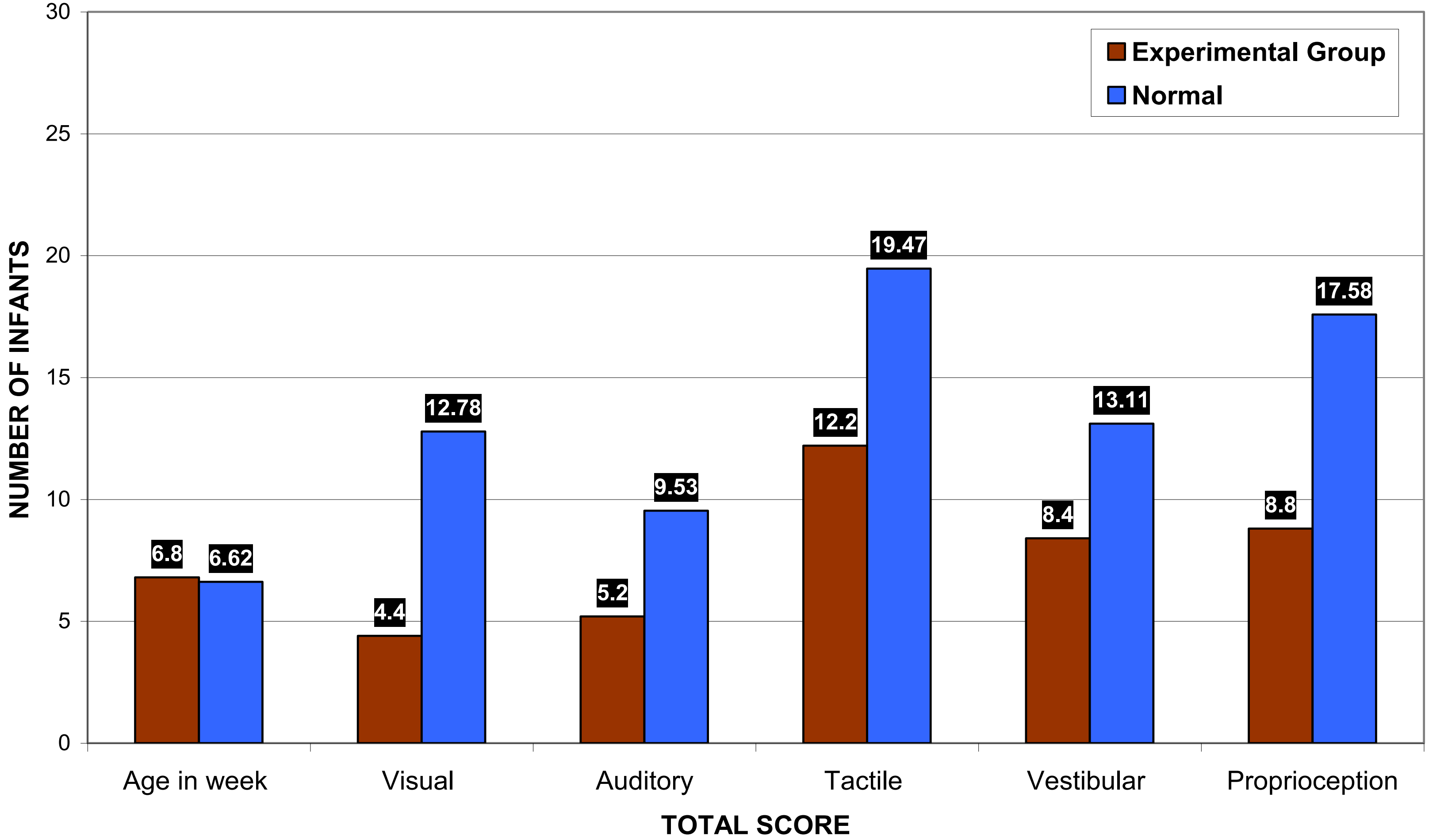


TABLE NO. 8

COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AGE MORE THAN 8 WEEKS

Total Score	Group	N	Mean	SD	SEM	T	Df	Sig. (2-tailed)
Age in weeks	Cont.	6	12.08	1.05	0.43	0.66	37	0.51 NS
	Nor.	33	11.58	1.82	0.32			
Visual	Cont.	6	11.33	7.50	3.06	-3.94	37	0.00 Sig.
	Nor.	33	23.21	6.67	1.16			
Auditory	Cont.	6	9.33	5.05	2.06	-2.78	37	0.01 Sig
	Nor.	33	13.76	3.31	0.58			
Tactile	Cont.	6	18.83	3.60	1.47	-2.86	37	0.01 Sig
	Nor.	33	22.39	2.66	0.46			
Vestibular	Cont.	6	11.33	5.01	2.04	-4.34	37	0.00 Sig
	Nor.	33	19.21	3.93	0.68			
Proprio-ception	Cont.	6	14.67	4.63	1.89	-0.06	37	0.95 NS
	Nor.	33	14.75	3.05	0.53			

A comparison of the ages showed that there was no significant difference between the 2 groups ($p > 0.05$). There was a significant differenced in the development of the auditory and tactile syste3ms between the normal and the control group ($p < 0.05$). The difference between the groups in the visual and vestibular domains was found to be highly significant ($p = 0.00$). The control group performed significantly less than the normals in all these domains. The development of the proprioceptive system in this age group was found to be equivalent to that of the normal group.

Fig. 4: COMPARISON BETWEEN NORMAL AND EXPERIMENTAL GROUPS AT AGE MOR THAN 8 WEEKS

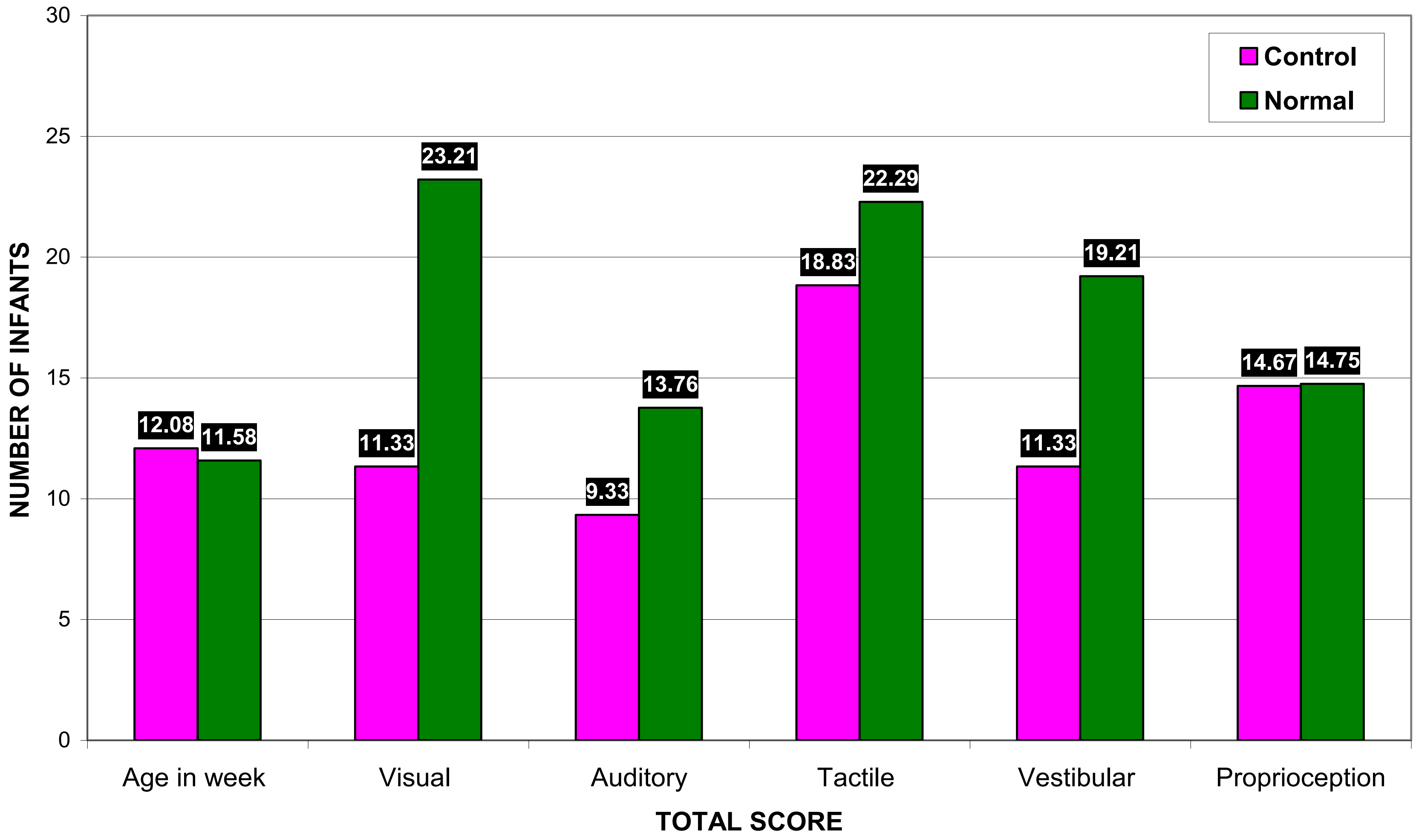


TABLE NO. 9

COMPARISON BETWEEN EXPERIMENTAL AND CONTROL GROUPS AGE 4- 8 WEEKS

Total Score	Group	N	Mean	SD	SEM	T	Df	Sig. (2-tailed)
Age in weeks	Exp.	3	6.23	0.15	8.82E-02	-1.42	4.40	0.22 NS
	Nor.	5	6.80	0.87	0.39			
Visual	Exp.	3	14.67	3.79	2.19	2.44	6	0.05 Sig.
	Nor.	5	4.40	6.54	2.93			
Auditory	Exp.	3	11.00	2.00	1.15	1.88	6	0.10 Sig
	Nor.	5	5.20	4.97	2.22			
Tactile	Exp.	3	19.00	1.00	0.59	2.69	4.43	0.05 Sig
	Nor.	5	12.20	5.50	2.46			
Vestibular	Exp.	3	15.33	4.04	2.23	2.28	6	0.06 Sig
	Nor.	5	8.40	4.22	1.89			
Proprio-ception	Exp.	3	18.33	1.15	0.67	3.29	4.43	0.03 Sig
	Nor.	5	8.80	6.30	2.82			

The results show that the 2 groups were matched in terms of age. There was no significant difference between the groups ($p > 0.05$). The scores of the experimental group showed a statistically significant difference in all the five sensory domains ($p < 0.05$). The results prove that the sensory development of the experimental group is significantly better that of control group in the 4-8 week age group.

Fig. 5: COMPARISON BETWEEN EXPERIMENTAL AND CONTROL GROUPS AT AGE 4-8 WEEKS

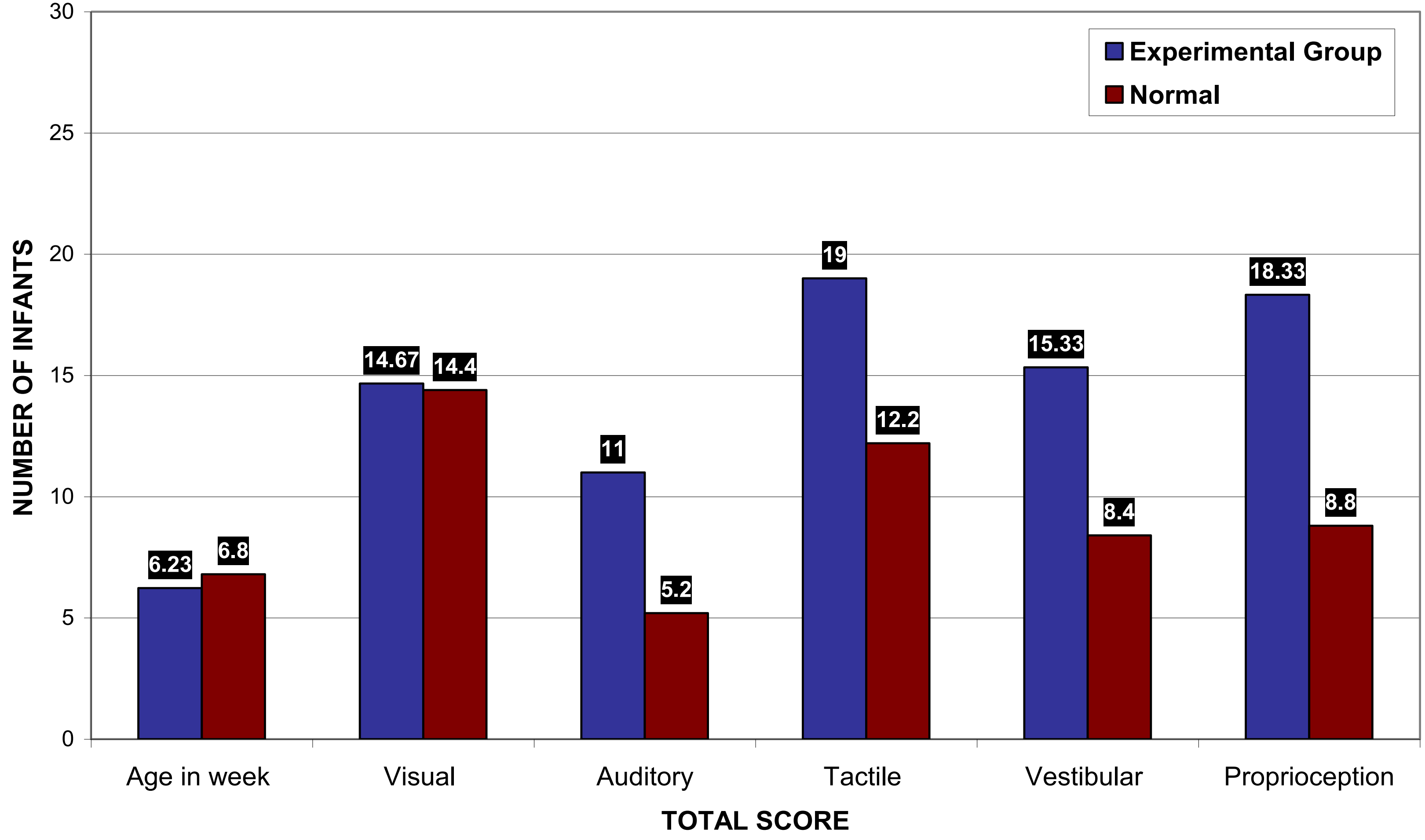


TABLE NO. 10

COMPARISON BETWEEN EXPERIMENTAL AND CONTROL GROUPS AGE MORE THAN 8 WEEKS

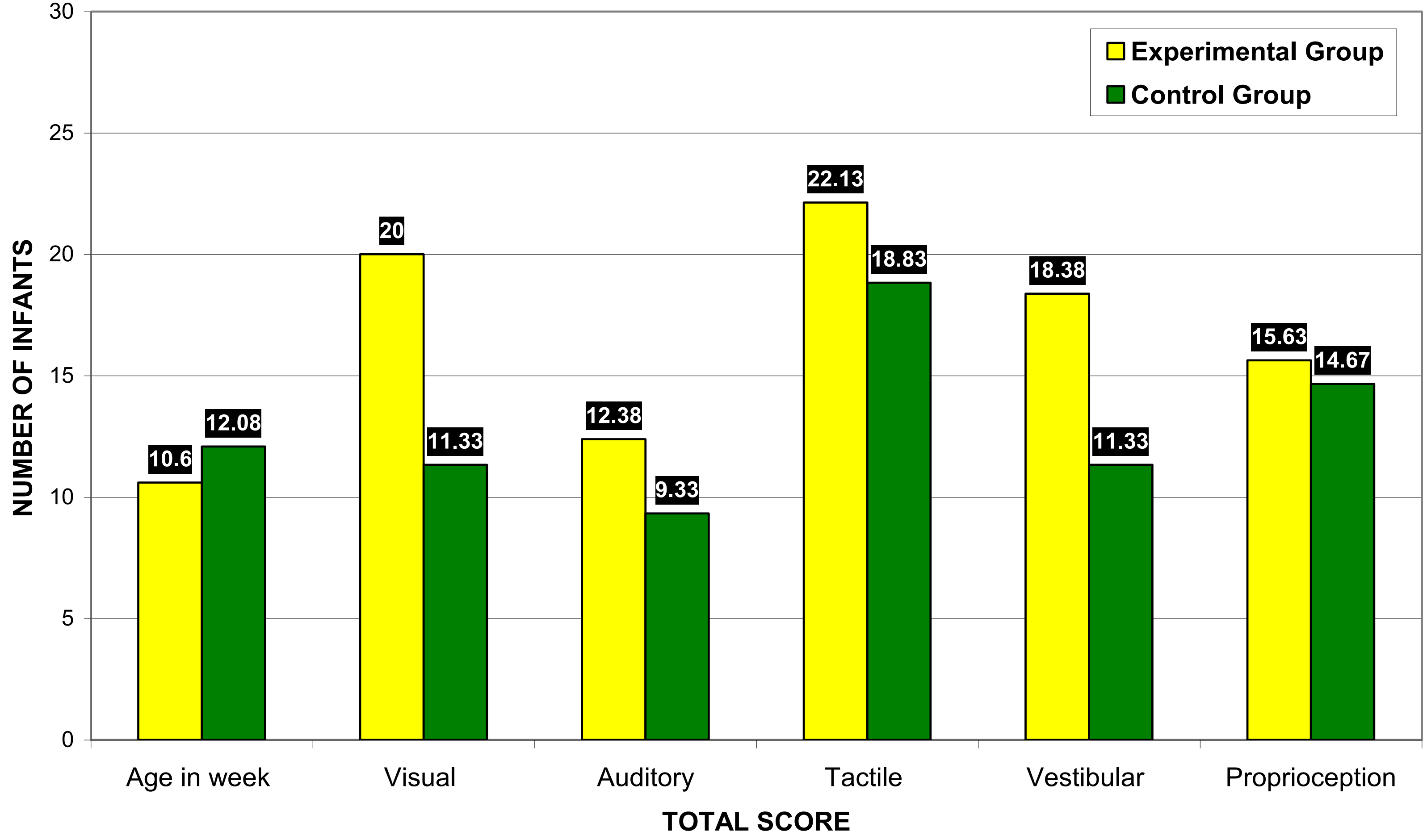
Total Score	Group	N	Mean	SD	SEM	T	Df	Sig. (2-tailed)
Age in weeks	Exp.	8	10.60	1.22	0.43	-2.38	12	0.04 Sig
	Cont.	6	12.08	1.05	0.43			
Visual	Exp.	8	20.00	8.83	3.12	1.93	12	0.08 Sig.
	Cont.	6	11.33	7.50	3.06			
Auditory	Exp.	8	12.38	6.35	2.24	0.96	12	0.35 NS
	Cont.	6	9.33	5.04	2.06			
Tactile	Exp.	8	22.13	3.52	1.25	1.71	12	0.10 Sig
	Cont.	6	18.83	3.60	1.47			
Vestibular	Exp.	8	18.38	5.15	1.82	2.56	12	0.03 Sig
	Cont.	6	11.33	5.01	2.04			
Proprio-ception	Exp.	8	15.63	1.41	0.50	0.49	5.7	0.64 NS
	Cont.	6	14.67	4.63	1.89			

The table shows a significant difference in the ages between the control and experimental group (p , 0.05). the infants in the control group were older than the ones in the experimental group. The experimental group performed significantly better ($p < 0.05$) than the control group in the tactile, visual, and vestibular domains.

The experimental group had higher scores than the control group in the auditory and proprioceptive domains but the difference was not found to be statistically significant.

It was seen that even though the mean age of the control group was higher than that of the experimental group, these high risk infants who did not receive intervention scored less than the experimental group in all domains.

Fig. 6: COMPARISON BETWEEN EXPERIMENTAL AND CONTROL GROUPS AT MORE THAN 8 WEEKS



DISCUSSION

The study revealed that the development of the four sensory systems including the visual, auditory, tactile, and vestibular systems increases with age. The infant acquires more skills as the age increases and learns to integrate all the senses to produce more complex adaptive behaviors. The proprioceptive domain evaluates predominantly the reflex maturation in infants, except for one subdomain, which evaluates for active movements. Since these primitive reflexes are present at birth and get integrated as the infant grows older the scores in this domain drop as age increases.

COMPARISON BETWEEN THE EXPERIMENTAL AND NORMAL GROUPS

The experimental group infants had low scores on initial evaluation suggesting the need for treatment. A comparison between the experimental and the normal group showed that the high risk infants who received intervention were able to perform at par with the normal. There was no significant difference at par with the normal. There was no significant difference in the development of the sensory systems between the two groups ($p > 0.05$). The experimental group had slightly higher scores than the normal group in the visual, auditory, vestibular and proprioceptive domains.

This result supports the study done by *(Rose G in 1982).* The performance of pre-term infants who had received tactile and vestibular stimulation for 2 weeks after birth was indistinguishable from the performance of the full term group.

During the study it was observed that one pre-term infant in the experimental group did not show improvements in the visual and auditory domains after 6 weeks of intervention. The infant was followed up at 4 months of age and was found to have a global delay in development with visual and auditory dysfunction. This finding reveals that infants with significant neurological handicaps may not show improvements with intervention. Such infants can thus be identified early and placed on intensive therapy to facilitate development.

These findings reveal that with intervention the development of the sensory system of high risk infants would be equivalent to that of normal infants, provided, there is no other significant neurological deficit.

Therefore, a delay in development in any of the systems could probably be an indication of a neurological deficit or environmental deprivation. Such infants can be identified early in order to provide intensive therapy.

COMPARISON BETWEEN CONTROLS AND NORMALS

The results showed that the performance of the control group was consistently less than that of the normal in the visual, tactile, and vestibular domains. Though the performance of the 4-8 group in the auditory domain, and the performance of the above 8 group in the proprioceptive domain, was less than that of the normal, the difference was not found to be statistically significant.

These results support the study done by Holmes DL, et al in 1982. Their study showed that pre-term and full term infants who required intensive care, performed poorly on the motor and interactive areas, when compared to the healthy full term infants.

These findings therefore support the need for early intervention in all high risk infants to promote normal sensory development.

COMPARISON BETWEEN EXPERIMENTAL AND CONTROL GROUP

The results showed that the high risk infants who received intervention performed significantly better than the control group in all the sensory domains in the 4-8 weeks group and in the visual, tactile, and vestibular domains in the more than 8 week group. These results support the study done by Sandra *Scarr-Salapatek, et al in 1973*. Their study showed that infants in the experimental group who were given special visual, tactile, and kinesthetic stimulation had a slight developmental advantage over the control group at 4 weeks of age. These results also support the study done by *Raweewan Lekskuchai, et al in 2001* on the effectiveness of a motor developmental program in improving performance in preterm Thai infants. The intervention group had shown significant improvement when compared to the controls. Thus this study supports the need for early sensory stimulation programs for biologically disadvantaged infants.

In this study the intervention given to the experimental group was parent focused. The control group received the regular follow up but the parents were not given the information and training as given to the experimental group. The results have shown a statistically significant difference between the experimental and control group. Moreover, during the final evaluation it was observed that parents of the infants, who received intervention, were much more interactive in comparison to the control group. Most of the parents in the experimental group showed awareness of the need for stimulation and had carried out the home program adequately. In contrast, the parents of the control group infants were found to be less interactive and irregular in carrying out the therapy taught to them during the monthly follow up. This discrepancy could be attributed to the lack of knowledge about the infant's behavior and normal development.

These findings support the previous studies done by other researchers. *Barrere ME, et al in 1986* had found that parent focused approaches had a greater impact on the development of pre - term infants. The study by Resnick MP, et al in *1987* reported similar results of a parent focused approach for low birth weight premature infants which attempted to enhance the quality of parent-child relationship. A study done by rice in 1977 revealed the effectiveness of a sensory- motor stimulation program taught to parents. He had concluded that his parent-provided treatment improved the infant's development and suggested that it also enhanced the mother-infant bonding. Field, et al in 1980 described the effectiveness of an intervention for low income mothers with Pre – term infants. All these findings have been supported by the results of this study.

It appears to be more advantageous to work directly with the parents than to work exclusively with infants. Therefore, it is suggested that parents be integrated into the development intervention programs from the very beginning.

From this study it can be seen that the earlier sensory intervention is started, the more opportunity is given for developing what ever potential there may be for normal abilities and for identifying any tendencies for delayed or abnormal development as early as possible.

CONCLUSION

This study was done to compare the sensory development between normal and high risk infants and to evaluate the effectiveness of an individualized parent focused stimulation program on the normal development. The following conclusions were drawn from this study.

1. The sensory development of high risk infants is significantly less when compared to normal in the visual, tactile, and vestibular systems. In the auditory and proprioceptive systems the development is less than normal but is not significantly.
2. The sensory development of high risk infants who received individualized intervention was equivalent to that of normal infants it they did not have any neurological deficits.
3. Sensory stimulation programs in the first 3 months of life is beneficial in facilitating the development of high risk infants.
4. Parent focused intervention is beneficial in facilitating infant development, positive parent – infant interaction and improving parent awareness of the need for stimulation.

Even though the sample size was small, the results are encouraging. A study on a larger scale with a bigger sample size would be useful in further emphasizing the need for early sensory stimulation and parental education for high risk infants.

LIMITAIONS & RECOMMENDATION

LIMITATIONS

- This study limited with the age group of 0-3 months of age.
- This study limited with small groups.
- This study is only limited on sensory profile.
- This study limited with duration of 4-6 months.

RECOMMENDATION

- Further study can be done with other age groups.
- Further study can be done with larger groups.
- Further study can be done taking only male or female babies.
- Further study can be done with other standardized profiles.
- Further study can be done with extended intervention duration.

REFERENCES

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APPENDIX-I

SENSORY PROFILE

Name:

Date of Birth :

Age :

Sex :

OPD No.:

Type of delivery :

SES :

Gestation Period :

APGAS Score :

Birth Weight :

Diagnosis :

High Risk Factors :

Head Circumference at Birth :

Comments :

Date :

Scoring Key

3 – Complete consistent response

2 – Complete inconsistent response

1 – Partial response

0 – No response

Sensory Profile	Score			Remarks
1. Visually regards				
2. Horizontal tracking – visually tracks object form side to side				
3. Tracks a moving person				
4. Vertical tracking – visually tracks object from forehead to chest				
5. Visually tracks object moving in a circle				
6. Social smile				
7. Moves arms actively on seeing the object				
8. Bats at object at chest level				
9. Looks at toy (or hand) to one side				
10. Looks at toy placed in hands at midline				
11. Brings toy and hand into visual field and looks at them when toy is placed in hand				
12. Turns head from side to side in response to stimuli in supine.				
Total Score				
Auditory				
1. Alerts – Ceases activity, quietens when a sound is presented				
2. Looks at person talking				
3. Visually searches for sound				
4. Turns head and searches for ear –level sound				
5. Moves arm actively in response to sound				
6. Localization of sound				

Total Score				
Sensory Profile	**Score**			**Remarks**
TACTILE				
1. Rooting and sucking reflexes				
2. Palmar grasp				
3. Plantar Grasp				
4. Flexor withdrawal of L/E				
5. Brings hand to mouth				
6. Can be comforted by holding				
7. Retains object placed in hand briefly				
8. Looks at or manipulates toys placed in hand				
9. Smiles to tactile stimulation (Tickle)				
Total Score				
Vestibular				
1. Moro reflex				
2. Neonatal neck righting reflex				
3. Can be comforted by rocking				
4. Head righting prone – lifts hand momentarily				
5. Head righting prone – lifts head and chest in midline				
6. Sitting with support – lifts head up intermittently				
7. Starts to lift head mild bobbing in sitting				
8. Holds erect with mild bobbing in sitting				
9. Right head from front and back in sitting				
Total Score				

SENSORY PROFILE	SCORE			Remarks
PROPRIOCEPTIVE				
1. Traction				
2. Placing – Plantar				
3. Placing – Palmar				
4. Neonatal positive supporting reaction				
5. Spontaneous stepping				
6. Kicks arms and legs smoothly				
7. A T N R				
Total Score				

APPENDIX-II

ASSESSMENT GUIDELINES

VISUAL

Visual Regard

Hold object 6-10” from the child’s eyes, move it gently to attract his or her attention.

Horizontal Tracking

Present an object at midline, about 12” from the child’s face. When the child looks at it, move it slowly to one side and then to the other side (e.g. 5-8” to either side). If the child does not track at all, vary the distance of the objects from the child’s eyes.

Tracks a Moving Person

Observe the child as a person (Mother) moves from one side to another within his/ her visual field.

Vertical Tracking

Present a bright object directly in front of the child about 12” from his or her eyes. When the child looks at the object, move it slowly to the level of the child’s chest and then back to the height of his or her forehead.

Visually Tracks Objects Moving in a Circle

Present an object at middle and attract the child's attention to it. Move the object slowly to one side and then move it in a circle a little larger than the child's face. If the child does not track vary the distance of the object, move the toy or alter illumination.

Social Smile

Observe the child's response when mother 'plays' with the child.

Moves Arms Actively on Seeing an Object

Place the child on his back, so the arms are free. Hold up a toy near the child, shaking it slightly if needed to catch his attention. As the child moves his arms move the object closer, so the child can touch it.

Bats at Object at Chest Level

Hold objects in front of the child at chest level and in the child's arms reach if necessary. Shake or move to attract his attention. If the child does not bat the object, move it closer and gradually move the object farther away to promote more active motion on the part of the child.

Looks at Hand (or Toy) to One Side

Use toy on one side and encourage to look on that side.

Looks at Toy Placed in Hands at Midline

Hold a toy in the child's reach and try to gain his attention by shaking; rattling or squeezing the toy. Once the child's hand is on the toy, shake the toy for the child. Try to let the child hold the toy independently merely try supporting it lightly.

Brings Toy and Hand into Visual Field and Looks at Them When Toy is Placed in Hand

Hold the toy in the visual field of the child. Manipulate in a manner that will gain the child's attention. Place the toy in the child's hand allowing him to bring it back into his visual field by himself.

Turns Head from Side to Side in Response to Visual Stimuli in Supine

Position the child comfortably with his head in midline. Move the toy to one side so that the child will turn his head. Shift toy to the opposite side still within visual field to see child's follow.

AUDITORY

- Alerts- Ceases Activity / Quietens When Sound is Presented Make sounds with a rattle for 3-5 seconds about 6" from the child's ear level, observe the child for any indication of decreased activity or alertness. Present the same to the other ear and observe.

Looks at Person Talking

Talk to the child in an animated fashion; try to make eye contact for as long as possible.

Visually Searches For Sound

Make sounds with a rattle for 3-5 seconds about 6” from the child’s ear at ear level. Observe the child’s eyes. Present the same rattle to the other ear.

Turns Head and Searches or Reaches for Ear Level Sound

Make sounds with a rattle about 6” from the child’s ear at ear level and observe his response. Test one ear and then the other.

Moves Arms Actively in Response to Sound

Place the child on his back so that arms are free to move. Hold a rattle, shake it slightly to catch his attention.

Localisation of Sound

Position the child comfortably with his head in midline, shake the rattle on one side. Observe child turning head to the side, repeat close to the other ear.

TACTILE

Rooting and Sucking Reflex

Touch the corner of the lip lightly to elicit a response of lowering of the bottom lip on the same side and tongue moving towards the point of stimulation.

Sucking is elicited by introducing a clean finger into the mouth.

Palmar Grasp

With the head in midline-Introduce a finger into the palm from the ulnar side. The finger will flex and grip the object, care is taken not to touch the dorsum of the hand.

Plantar Grasp

With the head in midline use a finger to gently stroke the sole of the foot behind the toes, the toes will flex to hold the finger.

Flexor Withdrawal of L/E

With the child in supine the sole of the foot is stroked firmly to elicit withdrawal (flexion on hip and knee, dorsi-flexion of foot with toe extension).

Brings Hand to Mouth

Observe the child to see if he takes hand to mouth.

Can be comforted by Holding

When child show distress, pick him up and hold gently but restraining the child from a great deal of body movement especially by holding the child's arms folded across his body.

Retains Objects Placed in Hand Briefly

Give a toy to the child and observe whether he holds the toy using a sustained grasp.

1. **Looks at or Manipulates Toys Placed in Hands**
2. **Smiles to Tactile Stimulation**
   Tickling the child in play

VESTIBULAR

1. Moro – Hold the baby at an angle of about 45" from the couch and then suddenly let the head fall back a short way. The reflex consists of abduction and extension of the arms and opening of the hands. This is followed by abduction and flexion of the arms, the hands close, and the child may cry.
2. Neonatal Neck Righting **-** With the child in supine, turning the head to one side results in 'log rolling' from supine to side.
3. When the child shows distress pick him up and hold him gently, but restraining the child from a great deal of body movement and gently rock the child.
4. Observe the child in prone.
5. Observe the child in prone.

6. Sitting with support – Observe the child in sitting with examiner holding the child.
7. Pull the child into sitting by gently pulling on his arms, observe for head lag.
8. Observe the child in supported sitting.
9. With the child in supported sitting, gently tilt head forwards and observe for righting.

PROPRIOCEPTIVE

Traction

Once the grasp reflex is obtained, the finger is gently drawn upwards. As this is done the grip is reinforced and there is a progressive tensing of the muscles from the wrist to the shoulder, until the baby hangs from the finger momentarily.

Placing

Plantar – The child is held in vertical suspension. Bring the anterior aspect of the dorsum of feet against the edge of a table. The child lifts the leg up to step onto the table.

Palmar

Bring the anterior aspect of the ulna or dorsal aspect of hand against the edge of table, the child elevates the arm to place the hand on the table.

Neonatal Positive Supporting

The child is held in vertical suspension with the sole of the feet on the table. The child shows partial weight bearing with hips and knees mildly flexed and ankle plantar flexed in contact with floor surface.

Spontaneous Stepping

The child is held in vertical suspension and the sole of the foot is pressed against the table with body inclined forwards. The child demonstrates rhythmic reciprocal flexion and extension of the legs simulating walking.

Observe the Child in Supine During the Assessment

Asymmetric Tonic Neck Reflex

The child in supine and not crying. Gently turn the head to one side. Observe or increase in extensor tone in the upper and lower extremities on the face side and flexor tone on the skull side.

APPENDIX-III

HIGH RISK FACTORS

	CHILD NUMBER	FACTORS
CONTROL	1.	Pre-term
	2.	Birth asphyxia/IUGR
	3.	Pre-term / low birth weight
	4.	Pre-term / hyperbilirubinemia
	5.	Low birth weight
	6.	Pre-term/hyperbilirubinemia / renal failure
	7.	Pre-term / low birth weight
	8.	Pre-term / hyperbilirubinemia / sepsis
	9.	Pre-term
	10.	Pre-term / neonatal septicemia / pyomeningitis
	11.	Pre-term / hyperbilirubinemia / septicemia
HIGH RISK / EXPERIMENTAL	1	Pre-term / low birth weight
	2	Pre-term / birth asphyxia / low birth weight
	3	Pre-term / low birth weight / birth asphyxia
	4	Pre – term / low birth weight
	5	Late onset septicemia / craniostenosis
	6	Pre-term / cleft palate
	7	Pre-term / low birth weight
	8	Pre-term
	9	Severe birth asphyxia
	10	Pre-term / metabolic convulsions / birth asphyxia
	11	Pre-term / hypoglycemic convulsion s/ IUGR

IUGR = Intra Uterine Growth Retardation

PT = Pre-Term   FT = Full Term

MASTER CHART EXPERIMENTAL – FINAL SCORE

No.	Age	Sex	GP	Type of Delivery	APGAR Score	HC (Cms)	B.Wt. (KG)	SES (Rs.)	Visual											
									1	2	3	4	5	6	7	8	9	10	11	12
1.	6.1	M	PT	LSCS	8,9,9	30.5	1.9	5000	3	3	3	3	3	3	1	0	0	0	0	0
2.	6.2	F	PT	LSCS	5,7,8	28.0	1.5	4000	3	3	3	2	1	1	0	0	0	0	0	0
3.	6.4	M	PT	NVD	3,6,7,	27.0	1.4	3000	3	3	3	1	1	1	0	0	0	0	0	0
4.	9.1	M	PT	NGD	8.9.9	30.0	1.7	200	3	3	3	2	2	2	0	0	0	0	0	0
5.	9.3	M	FT	LSCS	8,9,9	30.0	2.6	1000	3	3	3	3	3	2	1	3	1	1	0	0
6.	9.5	F	PT	LVD	8,9,9	32.0	2.2	1500	3	3	3	3	3	2	2	0	0	0	0	0
7.	10.1	F	PT	NVD	8,9,9	27.0	1.9	6000	3	3	3	3	3	3	2	2	2	2	1	0
8.	11.5	M	PT	NVD	8,9,9	32.0	2.0	1500	3	3	3	3	3	3	3	1	1	1	0	0
9.	11.6	M	FT	NVD	1,3,5,7,7	33.0	2.4	1500	3	3	3	3	3	3	2	2	0	0	0	0
10	11.6	F	PT	LSCS	5,7,9`	34.0	2.5	2500	1	0	0	0	0	0	0	0	0	0	0	0
11.	12.1	M	PT	LSCS	8,9,9	40.0	1.6	1500	3	3	3	3	3	3	3	3	0	0	0	0

	AUDITORY						**TACTILE**									**VESTIBULAR**									**PROPRIOCEPTIVE**						
No	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1.	**3**	**3**	**3**	**2**	**2**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**0**	**0**	**2**	**3**	**3**	**3**	**0**	**1**	**1**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**1**
2.	**3**	**3**	**3**	**2**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**0**	**0**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**1**
3.	**3**	**3**	**2**	**1**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**1**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**2**	**3**	**0**
4.	**3**	**3**	**3**	**3**	**1**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**0**
5.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**0**	**3**	**2**
6.	**1**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**1**	**0**	**1**	**3**	**3**	**3**	**1**	**3**	**1**	**1**	**0**	**1**	**3**	**3**	**3**	**2**	**3**	**2**
7.	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**3**	**1**	**3**	**1**	**3**	**1**	**2**	**3**	**3**	**2**	**0**	**3**	**1**
8.	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**3**	**0**
9.	**3**	**3**	**3**	**1**	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**0**	**3**	**3**	**3**	**1**	**1**	**3**	**0**
10.	**3**	**0**	**1**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**0**	**0**	**1**	**2**	**3**	**3**	**1**	**1**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**0**	**2**	**2**
11.	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**0**	**3**	**0**

MASTER CHART CONTROL – FINAL SCORE

No.	Age	Sex	GP	Type of Delivery	APGAR Score	HC (Cms)	B.Wt. (KG)	SES (Rs.)	Visual											
									1	2	3	4	5	6	7	8	9	10	11	12
1.	6.0	M	PT	NVD	8,9,9	30.5	2.75	1500	1	1	0	0	0	0	0	0	0	0	0	0
2.	6.1	F	FT	NVD	3,6,8	32.0	1.6	5000	0	0	0	0	0	0	0	0	0	0	0	0
3.	6.5	M	PT	LSCS	8,9,9	28.5	1.1	4000	2	0	0	0	0	0	0	0	0	0	0	0
4.	7.4	F	PT	NVD	8.9.9	29.0	1.75	1500	3	3	3	2	2	2	1	0	0	0	0	0
5.	8.0	F	FT	LSCS	8,9,9	31.0	1.6	600	1	1	0	0	0	0	0	0	0	0	0	0
6.	10.6	M	PT	NVD	8,9,9	30.0	1.2	5000	2	2	1	1	0	0	0	0	0	0	0	0
7.	11.0	M	PT	NVD	8,9,9	30.0	1.75	4000	3	2	1	1	1	0	0	0	0	0	0	0
8.	12.2	M	PT	LSCS	7,8,9	32	1.5	1200	3	3	3	3	3	3	1	0	0	0	0	0
9.	12.6	M	PT	NVD	8,9,9	29.0	2.0	3000	3	3	3	3	3	3	1	0	0	1	1	1
10	13.0	M	PT	NVD	8,9,9	33.0	2.1	4000	3	1	1	1	0	2	0	0	0	0	0	0
11.	13.1	F	PT	LSCS	6,7,8	26.5	2.1	2000	2	1	0	0	0	0	0	0	0	0	0	0

	AUDITORY						TACTILE									VESTIBULAR									PROPRIOCEPTIVE						
No	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1.	**3**	**1**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**3**	**1**	**3**	**3**	**1**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**0**	**0**	**0**	**1**
2.	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3.	**3**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**3**	**0**	**3**	**0**	**0**	**0**	**3**	**1**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**1**	**2**
4.	**3**	**3**	**3**	**3**	**2**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**3**	**1**	**3**	**1**	**0**	**1**	**0**	**3**	**1**	**3**	**3**	**3**	**3**	**0**	**3**	**0**
5.	**1**	**1**	**0**	**0**	**0**	**0**	**3**	**1**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**3**	**3**	**0**	**3**	**0**
6.	**3**	**2**	**2**	**2**	**0**	**0**	**3**	**3**	**3**	**2**	**3**	**3**	**0**	**0**	**0**	**2**	**0**	**3**	**1**	**0**	**1**	**0**	**1**	**0**	**3**	**3**	**3**	**3**	**3**	**2**	**1**
7.	**3**	**3**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**2**	**3**	**0**	**0**	**0**	**0**	**3**	**2**	**3**	**2**	**0**	**1**	**0**	**0**	**0**	**3**	**2**	**2**	**3**	**2**	**3**	**2**
8.	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**1**	**2**	**0**	**1**	**3**	**3**	**1**	**2**	**0**	**1**	**0**	**1**	**3**	**1**	**3**	**0**	**3**	**2**
9.	**3**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**0**	**3**	**3**	**3**	**3**	**3**	**0**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**0**
10.	**3**	**3**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**1**	**3**	**3**	**2**	**0**	**0**	**1**	**0**	**3**	**3**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**0**
11.	**3**	**1**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**3**	**3**	**3**	**0**	**0**	**0**	**3**	**0**	**3**	**1**	**0**	**0**	**0**	**0**	**0**	**3**	**3**	**3**	**2**	**0**	**2**	**3**